With regard to paragraph 1 of the Office Action, the applicant was obliged for the acknowledgement of receipt of the papers submitted.

With regard to paragraph 2 of the Office Action, the applicant was also obliged for the confirmation that the drawings were acceptable.

In reviewing the patent application to address the objections raised by the Examiner, it was noted that the paragraph at page 22 line 10 – page 23 line 4 was inconsistent in referring to the front projection display screen 60. This has been corrected in the above amended paragraph for page 10 line 22 – page 23 line 4. Copies of pages 22 and 23 showing the amendments in longhand are filed herewith for the Examiner's convenience.

In view of the objections in paragraphs 3 and 4 of the Office Action, claim 13 has been written as new claim 25, and claim 24 has been rewritten as new claim 36. In the new claim 25, wording has been chosen to try and meet the point raised by the Examiner and, in particular, to remove the reference to "varying the screen in shape and/or position". In the new claim 36, the phrase objected to by the Examiner as indefinite has been deleted. Claims 14 – 23 are now new claims 26 – 35 and they are unaltered. These claims are thus believed to be allowable because claim 25 is believed to be allowable.

With regard to paragraphs 5 – 7 of the Office Action, it is respectfully pointed out that the Examiner has not quite correctly represented what Wynn (GB 2317297A) discloses. More specifically, the Examiner has said that Wynn discloses a collimating mirror (5). However the new claim 25 (and also the old claim 13) require that the collimating mirror be a curved collimating mirror. Wynn does not disclose a curved collimating mirror, and the curved collimating mirror is an essential part of the applicant's invention.

Still further, as the Examiner admits, Wynn does not teach a method of selecting the shape and/or position of the screen in order to provide a variable image distance within the total field-of-view of the display apparatus.

A person seeking to make the invention of the present application and looking at the Wynn specification would thus not find two features which are essential to the applicant's invention. The combination of Wynn with Yamasaki et al (USA Patent No. 5547382) will not give the applicant's invention as claimed.

Yamasaki et al does not describe variation of image distance within the total field of view. Rather, Yamasaki et al discusses variation in image <u>content</u> as generated by a computer image generator, in response to head and motorcycle movement, in order to make the visual and motion cues correspond – as Figures 9a – 9c describe.

It is believed from the above that the Examiner will appreciate that Wynn and Yamasaki et al are just not directed to the same type of invention as the applicant's present invention.

Accordingly, it is respectfully submitted that this application is in condition for allowance. Early and favourable action is respectfully requested.

If for any reason this RESPONSE is found to be INCOMPLETE, or if at any time it appears that a TELEPHONE CONFERENCE with Counsel would help advance prosecution, please telephone the undersigned or one of his associates, collect in Waltham, Massachusetts, at (781) 890-5678.

Respectfully submitted,

Jason D. Shanske
Reg. No. 43,915

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any ground vehicles with a low cost motion system. Further, a head mounted display allows the driver to look in any direction without limitation from the display device. Such a combination of features is difficult if not impossible to achieve with projected out-of-the-window displays. However, there are two fundamental reasons why head mounted display apparatus has not been widely accepted for ground vehicle driving simulators. The first reason is that in the real world, drivers do not need to wear headgear. The second reason is that the visual performance of head mounted display apparatus to date has not been adequate, especially with regard to transport delay, compensation for head movement, and field-of-view. Furthermore, optical limitations (for example resulting in eye strain or sickness) and discomfort (for example weight, centre of gravity and hygiene) are significant problems.

It is an aim of the present invention to ~~provide display apparatus which~~ reduce the above mentioned problems.

Accordingly, in ~~one non-limiting~~ one embodiment of the present invention, there is provided a method of producing display apparatus, which method comprising ~~a front~~ providing a curved projection screen, providing at least one projector ~~which is~~ for providing a display on the screen, ~~and which is~~ positioning the said at least one projector outside an enclosed display volume, ~~the screen being varied~~ in shape providing a curved collimating mirror via which the image is viewed such that the image distance is greater than the radius of the mirror, and varying

Insert the attached marked with a ☆ here

and/or position in order to vary the image distance within the total field-of-view of the display apparatus ~~when viewed via a curved collimating mirror~~.

The display apparatus of the present invention may be for simulators such for example as flight simulators and ground vehicle driving simulators. The display apparatus may be used for other simulators if desired. The display apparatus may also be used in non-simulator applications so that the display apparatus may be for visualisation and virtual reality systems where similar display characteristics would be of benefit.

The display apparatus of the present invention may enable ground vehicle driving simulators to be produced with the following advantages.

1. Low cost.
2. Close image distance on the driver's side.
3. Longer image distance elsewhere.
4. Continuous image of high contrast and luminance.
5. Low maintenance.
6. Light weight.
7. Re-use of the design to eliminate one time costs in the simulator structures.
8. Flexibility to change simulator cabs.

The display apparatus of the present invention may be used to provide a highly integrated motion and display platform with well defined interfaces. This may

accepted for training for two reasons. Firstly, in the real world, drivers do not need to wear head gear. Secondly, visual performance of head mounted display based systems is not adequate, especially with regard to transport delay, compensation for head movement, and field-of-view. Furthermore, optical limitations may result in eye strain and sickness. Discomfort such as weight, centre of gravity and hygiene due to wearing the head mounted display may also be a problem.

Referring now to Figures 9 and 10, there is shown display apparatus 50 of the present invention. The display apparatus 50 comprises a curved front projection display screen ~~62~~ 60, a plurality of projectors 54, and a collimating mirror 62 which is formed from aluminised polyester film drawn to a partial vacuum using a chamber 52. One projector 54 is shown in Figure 9 for simplicity of illustration. Two projectors 54 are shown in Figure 10. Also shown in Figures 9 and 10 is a cab 56. Figure 9 shows a driver 58 in the cab 56. The projectors 54 are for providing a display on the screen 60 which is of the front projection type in that an image is reflected from the same surface on to which it is prbjected. As can be seen, the projectors 54 are positioned behind the mirror chamber 52. The front projection ~~surface~~ display screen 60 is utilised for receiving images from the projectors 54 as shown. The image formed

on the front projection display screen ~~surface~~ 60 is viewed by the driver 58 via the collimating mirror 62, thus setting the apparent image distance at some value greater than the radius of the collimating mirror 62.

The projectors 54 are arranged outside the mirror chamber 52 and they fire radially inboard on to the front projection surface of the screen 60. The screen 60 can be produced at significantly less expense than the screen 28 shown in Figure 7. The projectors 54 can be liquid crystal display projectors or other low maintenance fixed matrix projectors.

The display apparatus 50 may present three problems in itself, these being as follows.

1. **FOCUS**

The reverse screen curvature is not the intended application for off-the-shelf lenses to be found on projectors. However, high F-number optics characteristic of fixed matrix projectors and appropriate techniques can be utilised to overcome this problem at low cost.

2. **DISTORTION**

The reverse screen curvature creates a problem in that it tends to form primarily pin cushion and trapezoidal distortion to the projected channel images. Distortion correction means may be employed to eliminate this problem. The distortion means may apply a bi-

The present invention provides a method of producing display apparatus, which method comprises providing a curved projection screen, providing at least one projector for providing a display on the screen, positioning the said at least one projector outside an enclosed display volume, providing a curved collimating mirror via which the image is viewed such that the image distance is greater than the radius of the mirror, and selecting the shape and/or position of the screen in order to provide a variable image distance within the total field-of-view of the display apparatus.

The present invention also provides a method of producing display apparatus, which method comprises providing a curved projection screen, at least one projector which is for providing an image on the screen, and a curved collimating mirror via which the image is viewed, and the method being such as to vary the screen shape and/or dimension from its center in its design and manufacture, with the effect that the apparent image distance, as viewed via the collimating mirror, varies in response to the variation in screen shape and/or dimension.

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